Pain Management in Ferrets

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Along with the growing popularity of ferrets as pets comes the demand for advanced veterinary care for these patients. The number of ferrets brought to the veterinarian has steadily increased and might increase even further over the coming years. Among these ferrets are individuals experiencing a painful condition. Pain is associated with a broad range of conditions, including acute or chronic inflammatory disease, neoplasia, and trauma, as well as iatrogenic causes, such as surgery and diagnostic procedures. Pain should be treated from a welfare, ethical, and medical perspective. It is well documented that poor pain management in the postoperative period has detrimental effects on recovery, including wound healing and maximal restoration of function of the patient.[1,2]

Effective pain management requires knowledge and skills to assess pain, good understanding of the pathophysiology of pain, and general knowledge of pharmacologic and pharmacodynamic principles. Veterinarians also need to consider species-specific issues and requirements regarding the aforementioned items. Unfortunately, scientific studies on efficacy, pharmacokinetics, pharmacodynamics, and safety of analgesic drugs in the ferret are limited. However, basic rules in the treatment of pain and on mechanisms of action, safety, and efficacy of analgesic drugs in other species can be adapted and applied to pain management in ferrets.

This article aims to make an inventory of what is known on the recognition of pain in ferrets, what analgesic drugs are currently used in ferrets, and how they can be adopted in a patient-orientated pain management plan to provide effective pain relief while reducing and monitoring for unwanted side effects.

RECOGNIZING PAIN

One should be able to recognize pain to treat it. Recognizing pain in animals is difficult, primarily because of the lack of verbal communication. In veterinary medicine, it is well

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known that different species express pain in different ways. There is a strong supposition that solitary-living animals and prey animals are masters of disguising pain. Different forms of pain might induce different types of pain-related behaviors, complicating the recognition of pain even more. Therefore, pain scales should include behavioral parameters that are species-specific, can be objectively assessed, and indicate different forms of pain, for example, pain due to trauma, acute postoperative pain, pain from the musculoskeletal system, visceral pain, and inflammatory pain.

Although ferrets are used as laboratory models in neurophysiologic studies, including studies involving nociception and pain,[3–9] most of these studies do not report on the behavioral changes potentially related to nociception and pain.

To determine specific behavioral signs of pain in ferrets, one should get familiar with the normal behavior of this species first.[10,11] Flecknell[10] stresses the need for taking the time to adequately observe the animal to assess whether it is in pain or not. Making adequate assessments in ferrets may therefore be impaired by their normal activity levels, because they spend up to 70% of their time per day sleeping, with short episodes of activity in between.[12,13] Therefore, waiting for the ferret to be awake and display active behavior is recommended for making a sound assessment of the animal. Behavioral characteristics that are frequently seen in animals with pain are (1) diminished general activity and exploratory behavior in a new environment; (2) altered posture (in many animals, a hunched posture but in ferrets, the normal hunchback is now absent); (3) altered gait, such as lameness; (4) uncharacteristic aggression in animals that are otherwise very friendly; (5) apathy in animals that are otherwise fierce; (6) vocalizations that differ in pitch and pattern from the normal interactive sounds; (7) hiding in the back of the cage facing away from the observer; (8) lack of grooming behavior resulting in ruffled and unkempt appearance of the hair coat; (9) diminished food and water intake, especially in dental or gastrointestinal pain; (10) bruxism, especially in abdominal pain; and (11) aversive response to external palpation of the animal.

A gross subset of behavioral signs of pain in the ferret has been described in clinical reviews.[14,15] The signs included anorexia, lethargy, crying, stiff movements, inability to curl into a sleeping position, and squinting; however, these reports did not mention whether and how the clinical validity of these parameters was established. Johnston[11] describes some specific pain-related behaviors that he encountered as a clinician working with ferrets. These behaviors include inactivity, staying curled in a ball (opposed to what Brown[14] and Pollock[15] reported), aggression, teeth-baring when being disturbed, decreased appetite, shivering when body temperature is normal, bristling of the tail fur, half-closed eyelids, focal muscle fasciculations, high-pitched vocalization or grunting when handled, lameness, and general malaise. Behavioral parameters of pain in ferrets described by Lichtenberger and Ko[16] include depression, immobility, silent demeanor, distanced from their environment, half-closed eyes, lack of grooming behavior, bruxism, and hiding themselves.

Sladky and colleagues[17] describe behavioral parameters of pain in ferrets in a study on the effectiveness of epidural morphine for postoperative analgesia after ovariohysterectomy and anal sacculectomy. The authors adapted a pain scale used in scoring pain in dogs after ovariohysterectomy by Hardie and colleagues.[18] Also, an ethogram of different behavioral parameters was made to extract possible pain-related behaviors. Although the number of animals in the control and treatment group was small and the duration of behavior assessed was short, a few behavioral parameters were suggested to be related to pain. These parameters were restricted/labored respiratory patterns, trembling, and attenuation of movement on rubbing the site of incision over the edge of the nest box when climbing it. Other, more traditional parameters of postoperative pain in animals, such as licking the incision site, droopiness, and obliviousness did not differ between the control and treatment group. Intuitively, the reaction in response to rubbing or touching the incision site indicating effectiveness of postoperative analgesic treatment makes sense. This parameter seems also to be a robust parameter in pain scales in dogs and cats.[18–20]

All the aforementioned behaviors are nonspecific and are also mentioned in descriptions of pain in other mammals. Pain-related behaviors in ferrets can, however, also be very subtle, as demonstrated in a study by Chattipakorn and colleagues.[7] This study established that the most significant behavioral change related to pain resulting from a tooth pulp inflammatory process was ipsilateral tongue protrusions, that is, the tongue protrusions were more often aimed toward the affected side. Other behaviors, such as face-wash strokes, headshakes, fore limb flails, paw-licks, ear grasps and chin rubs, seemed less specific. Most likely, such subtle behavioral changes are best detected by people spending a fair amount of time with the animal and observing it closely. In veterinary practice, these people are most likely to be the owner or veterinary technicians. It is therefore of pivotal importance to recognize the value of assessments made by the owner or technicians. The latter can be instructed to look for subtle changes in the animal's daily behavior. If frequent reports of specific behavioral signs are made in ferrets that are possibly in pain, these behaviors might be adopted for use in assessing pain in other individuals. To validate whether such behaviors are indeed related to pain, one can treat animals showing this behavior with analgesics, and evaluate the effect of the treatment on the display (attenuation or discontinuation) of the behavior. Although most of the signs of pain in ferrets currently reported seem relevant to acute postoperative pain, *home assessments* by the owner could also be valuable in detecting specific signs of chronic pain. In cats suffering from degenerative joint disease (DJD), for example, owners notice that the cats show a decrease in height and frequency of jumping, a reluctance to groom, and a decrease in food intake. Furthermore, these parameters seem strongly associated with radiological findings and are responsive to analgesic therapy.[21,22] In ferrets, the incidence of chronic pain due to, for example, DJD is unknown, and to date, the signs of chronic pain are not well documented. Similar to dogs and cats, one might expect ferrets with chronic pain to be hampered in their daily playful behavior, which might be easily noticed by the observant owner. However, such assessments are also prone to placebo effects, and therefore, should be interpreted with caution.[23,24]

Physiologic parameters, such as heart-rate and blood pressure, are sometimes used to assess pain in animals. However, because these parameters are not easily measured in ferrets and the restraint needed to record them would actually influence the recorded values, the mainstay of pain assessment in ferrets would be the behavioral assessment.[16]

Finally, many behavioral signs of pain in ferrets are described in the literature; however, the scientific evidence validating these parameters is limited. Effectiveness of analgesic therapy in ferrets can be assessed by observing and clinically examining the animal without costly equipment or complex procedures to make the assessment. All clinicians working with ferrets might develop their own pain scale for ferrets based on the experience of the clinic's employees for practical implementation in their specific clinic. Technicians and owners who spend a lot of time with the animals are invaluable in assessing the adequacy of analgesia, because they can quickly determine what is normal and abnormal for that individual animal. With minimal investment, a high gain can be achieved for adequate analgesic treatment and hence animal welfare.

PAIN PATHOPHYSIOLOGY

The basic approach to analgesic treatment in ferrets does not differ from the approach in humans and other commonly treated species, such as dogs and cats. Effective treatment of pain requires a basic understanding of the neuroanatomic and neurophysiologic background of pain. This background is described in most handbooks about pain, anesthesia, and analgesia and is beyond the scope of this article.

Different classes of analgesic drugs can be used to stop or reduce the nociceptive input at different stages, that is, transduction, transmission, modulation, projection, and perception of the pain pathway. This is the basis of multimodal approach to pain management.[25] Transduction of pain can be influenced by local anesthetics and nonsteroidal anti-inflammatory drugs (NSAIDs); transmission, by local anesthetics, opioids, and alpha-2 agonists; modulation, by local anesthetics, NSAIDs, opioids, alpha-2 agonists, and N-Methyl D-Aspartate (NMDA) agonistic drugs; projection, by opioids, alpha-2 agonists, and NMDA agonistic drugs; and perception, by inhalational anesthetics, opioids, and alpha-2 agonists. The advantage of a multimodal approach is that different classes of analgesic drugs can have additive or synergistic effects. Furthermore, when using a combination of different analgesic drugs, the dose of the individual drugs can be lowered, which, in turn, might reduce side effects and increase safety.

Another important aspect of increasing the efficacy of analgesic therapy is preemptive analgesia. It has been shown in both humans and animals that previous experiences of pain can increase the aversiveness of subsequent painful events; although controversy on this topic persists,[26] pain might be treated best preemptively.

IMPLICATIONS OF THE UNIQUE PHYSIOLOGY OF FERRETS IN DESIGNING A PAIN MANAGEMENT PLAN

Diminished food and water intake in animals that are in pain can result in catabolic states and hypoglycemia in those with high metabolic rates.[10] Ferrets have short intestinal tracts and very fast intestinal transit times. Consequently, ferrets digest their food inefficiently.[27] The inefficient digestion and high metabolic rate of ferrets make them susceptible to developing a hypoglycemic state in the perianesthetic period.[28] The development of hypoglycemia can be enhanced by the presence of insulinoma (clinical or subclinical), which is common in companion ferrets.[29] Finally, inadequate pain treatment in ferrets recovering from surgery or suffering from critically illness might result in the development of hypoglycemia, which can potentially be life threatening. This underlines the pivotal importance of adequate monitoring and supportive care, including proper analgesic treatment, of ferrets.

Small animals, especially with long and thin bodies such as ferrets, are prone to develop hypothermia in the perianesthetic period. A field study anesthetizing free-ranging mink and polecats with ketamine and medetomidine reported a rapid decrease in body temperature after induction of anesthesia.[30] Inactivity due to inadequate pain treatment or overt sedation caused by analgesics can lead to the development of hypothermia, especially during postoperative recovery.[10] Because hypothermia is an important risk factor during the postoperative recovery period,[31] early intervention, including adequate analgesic support, and close monitoring in the postoperative period are of great importance in ferrets.

A study of the ferret liver's metabolizing of acetaminophen concluded that the activity of the hepatic enzyme glucuronosyltransferase in ferrets is similar to that in cats and that consequently, ferrets have a poor ability of glucuronidation of NSAIDs.[32] However, this was an in vitro study using microsomal preparations from frozen livers, and no in vivo results of the clearance of NSAIDs in ferrets were provided. Furthermore, it was concluded that ferrets do not share the same background that causes the relative poor activity of glucuronosyltransferase as cats. Also, glucuronidation is not the only way in which NSAIDs are metabolized or cleared from the body. Excretion of unchanged flunixin into the bile via organic anion transporters and thioesterification of ketoprofen are proposed as major excretion routes for these compounds in cats.[33] Therefore, in ferrets, other ways of metabolizing and excreting NSAIDs may also be present. Consequently, it cannot be readily concluded that ferrets have a diminished capacity for metabolizing and excreting NSAIDs similar to cats; however, it emphasizes the need for proper scientific studies into the pharmacodynamics and safety of NSAIDs and other analgesic drugs in ferrets. Until these studies are available, it might be prudent to extrapolate data on the use of NSAIDs in the cat to ferrets. Analogous with cats, close monitoring of the signs of side effects on the gastrointestinal tract and kidneys of the ferret is recommended when long-term use of NSAID is instituted.

THERAPEUTICS

As argued earlier, preemptive and multimodal analgesia, methodically intervening in the normal nociceptive pathway with different analgesics at the same and also distinct neuroanatomic levels, is part of effective pain management in humans and animals alike. The broad range of analgesic drugs used in more common companion species, such as dogs and cats, are also used in ferrets. Although the number of reports on analgesic efficacy, pharmacokinetics, and safety of the different drugs in ferrets is limited, a substantial number do exist on the clinical experience with these drugs. The reported doses, dose intervals, and routes of administration of the drugs described in the following sections are provided in **Table 1**.

NSAIDs

NSAIDs exert their effects by inhibiting the enzymes cyclo-oxygenase 1 and 2 (COX-1 and COX-2). The COX enzymes are responsible for the production of prostaglandins, among others, which play an important role in inflammatory processes and in regulating renal and gastrointestinal mucosal perfusion. The analgesic effects and the most important side effects, kidney failure and gastro-intestinal ulceration, are mediated by a reduction in the production of prostaglandins. A detailed description of the analgesic and side effects of NSAIDs goes beyond the scope of this article.

NSAIDs should be used with care for long-term treatment and are contraindicated in pregnant animals; animals with hepatic, renal, or gastrointestinal disorders; and/or animals that are in shock.[11] Contraindications for the use of NSAIDs are critically ill patients, preexisting renal disease, hypovolemia, bleeding disorders, and expected severe blood loss during surgery.[16] A recent report, however, states that preexisting renal disease is not necessarily a contraindication to the use of NSAIDs in cats,[34] but whether this also applies to ferrets is unclear currently. Pollock[35] states that NSAIDs are a poor choice for ferrets, because helicobacter gastritis and ulceration may develop with any concurrent stressor; however, there is no reference to support this statement. Based on the substantial number of reports on the successful use of NSAIDs in ferrets, these drugs can be considered a valuable additive to analgesic therapy in this species.

The use of meloxicam and carprofen, both potent COX-2 inhibitors, in ferrets is described by various authors.[16,35–38] Both drugs are stated to be relatively safe for ferrets and can be administered orally or by subcutaneous injection.[10,16,35] Flecknell[10] mentions that carprofen does not induce renal damage and therefore can be used

Table 1
Dose intervals and routes of administration of ferret analgesia drugs

Drug	Dose (mg/kg)	Route	Interval (h)	References
Opioids				
Buprenorphine	0.01–0.03	IV, IM, SC	8–12	10
	0.01–0.03	IM, PO, SC	6–10	11
	0.01–0.05	IV, SC	8–12	14
	0.01–0.03	IM, IV, SC	8–12	35
	0.004–0.01	IM, SC	6–8	39
Butorphanol	0.4	IM	4–6	10
	0.1–0.4	IM, IV, SC	2–4	11
	0.1–0.2 mg/kg/h CRI	IV		11
	0.1–0.5	IM, IV, SC	4–6	14
	0.1–0.2 loading dose followed by 0.1–0.2 mg/kg/h CRI	IV		16
	0.05–0.4	IM, SC	4–12	35
	0.2	IM, SC		39
Hydromorphone	0.1–0.2	IM, IV,SC	6–8	11
	0.05 loading dose followed by 0.05–0.1 mg/kg/h CRI	IV		16
Oxymorphone	0.05–0.2	IM, IV, SC	6–8	11
	0.05–0.2	IM, SC		35
Morphine	0.5–5	IM, SC	6	10
	0.05–0.5	IM, SC	2–6	35
Fentanyl	1–4 µg/kg/h CRI	IV		11
	2.5–5 µg/kg/h CRI (combined with ketamine CRI)	IV		16
Tramadol	10	PO	24	16
NSAIDS				
Meloxicam	0.1–0.2	PO, SC	24	11
	0.2 starting dose, followed by 0.1	IV, PO, SC	24	16
Carprofen	2.0–4.0	SC	24	10
	4.0	PO	24	16
	1.0–4.0	SC	12–24	35
Flunixin meglumine	0.5–2.0	SC	12–24	10
	1.1	PO, SC	14	14
	0.3–2.0	IV, PO, SC	24	35
Ketoprofen	1.0–2.0		24	16
	1.0–5.0	IM, PO	24	35
Other				
Ketamine	2.0 µg/kg/min	IV		11
	0.3–0.4 mg/kg/h with fentanyl CRI	IV		16
Medetomidine	0.001–0.002	IM,IV	4–6	16

Abbreviations: CRI, constant rate infusion; IM, intramuscular; IV, intravenous; PO, by mouth; SC, subcutaneous.

preoperatively, because no negative effects on renal function are expected when hypotension is encountered during surgery. However, the authors' do not know of any scientific data to support these statements.

Flunixin meglumine and ketoprofen, both potent COX-1 and COX-2 inhibitors, are described as being used in ferrets.[10,14,35] It is recommended that the latter drug is used with caution and only postoperatively, because of the expected negative effects on renal function and on the gastrointestinal mucosa.[10,16] However, no safety or toxicity studies for ferrets are available for either drug.

Finally, the authors consider NSAIDs valuable in analgesic therapy in the ferret. Since no clear safety studies are available, they should, however, be used with caution and/or appropriate monitoring intervals.

Opioids and Tramadol

Opioids exert their analgesic effects by agonistic effects on the opioid μ, κ, and/or δ receptor. The use of different types of opioids has been described in ferrets.

The use of buprenorphine in ferrets is described by various authors.[11,16,36–40] During a recent consensus meeting, buprenorphine was designated as a full μ-opioid receptor agonist in humans, with potent analgesic actions and few side effects, such as respiratory depression, nausea, and dysphoria.[41] Different authors assume different lengths for the duration of its analgesic actions, varying from 6 to 12 hours. It is reported that in ferrets, buprenorphine has profound sedative effects in the higher dose range.[11,14] Brown[14] suggests counteracting the sedative effects by giving naloxone at a dose of 0.04 mg/kg intravenously. However, antagonizing the sedative effects of opioids by the use of a full antagonist like naloxone also antagonizes the analgesic effects. In the human literature, there is controversy on this topic; however, several studies have demonstrated that naloxone can reverse the negative side effects of opioids, such as nausea, pruritus, and sedation, while keeping sufficient analgesia.[42,43] However, in animals, the lack of analgesia after (partially) antagonizing opioid effects by naloxone is not as readily assessable as in humans. Therefore, the authors advise to titrate opioids, especially those with a fast onset time (eg, morphine, methadone, fentanyl) to effect, but not to reverse the sedative effects with naloxone in ferrets. Furthermore, the authors advise that the animal be reassessed 30 to 60 minutes before the next dose of opioids, to identify inadequate long dose intervals or signs potentially associated with opioid adverse effects. When significant sedative effects or other negative side effects are encountered, the subsequent opioid dose can be reduced and the animal's analgesia reassessed.

Butorphanol is also frequently used to provide analgesia in ferrets.[11,14,16,36,39,44] It is assumed that butorphanol has agonistic effects on μ-, δ-, and κ-opioid receptors, with the highest affinity for the κ-opioid receptor.[45] Its clinical effects seem similar to buprenorphine; however, the duration of its analgesic actions seem significantly shorter—a maximum of 4 to 6 hours.[14,39] Therefore, the authors recommend the use of buprenorphine over butorphanol in ferrets.

The use of morphine, a μ-opioid receptor agonist,[46] in ferrets is reported.[10,11,35] Nausea and vomiting in response to morphine in its clinical dose range are described.[35] A study by Shiokawa and colleagues[47] also describes retching and vomiting in ferrets in response to the use of morphine in doses less than the clinical dose range—0.1, 0.3, and 0.6 mg/kg subcutaneously. Although this study used naïve, pain-free ferrets as an animal model to determine the antiemetic effect of aripiprazole, a partial dopamine D2 agonist, the findings support the clinical experience that morphine induces nausea and vomiting in the ferret. It might therefore be concluded that morphine should be used with caution in this species.

Methadone is a μ-opioid receptor agonist. In dogs, the incidence of methadone-associated vomiting was lower compared with morphine.[48] In humans, it is reported that opioid-associated side effects are lower when using methadone compared with morphine. However, strong scientific evidence to support this is lacking. Unlike in North America and the United Kingdom, methadone is readily available in mainland Europe. Therefore, it is used there more frequently than morphine in most species, except for the epidural and intra-articular route. In the authors' knowledge, the use of methadone in ferrets has not been described; however, it may be a valuable alternative to morphine in this species as well.

The use of hydromorphone and oxymorphone in ferrets, both μ-opioid receptor agonists,[46] is described.[11,16] For both agents, no clear descriptions exist of the clinical effects and duration thereof in ferrets. Based on the described dose intervals by Johnston,[11] clinical action can be assumed to last 6 to 8 hours.

The use of fentanyl, a short acting and very potent μ-opioid receptor agonist[46] with potent analgesic actions, has been described by Johnston[11] and Lichtenberger and Ko.[16] As in other species, fentanyl can be used as a constant rate infusion (CRI) in ferrets. Fentanyl CRI is most often used during surgery and in the postoperative period, but in the authors' opinion, can also be useful in trauma patients needing potent analgesia. Frequent reassessment, including ventilatory status and effectiveness of pain management, is mandatory in these patients.

The use of tramadol in the ferret has been described.[11,16] Tramadol is not a typical opioid. It is described to have effects on the μ-opioid receptor and the serotonin , the catecholamine, and the γ-aminobutyric acid systems. Tramadol is described as having significant analgesic effects in humans without inducing dependence.[46] In veterinary medicine, only a few studies on its analgesic effects in cats are available[49–51] and none, in dogs. The clinical effective dose in cats is 4 mg/kg with a dosing interval of 6 hours. This differs substantially from the dose and interval reported for the ferret by Lichtenberger and Ko,[16] that is, 10 mg/kg once daily. In cats, the palatability of tramadol is a significant clinical problem. Currently, its analgesic efficacy and palatability in ferrets is not described.

Finally, the clinical effects of opioids in ferrets seem to be similar to those in other species. Opioids, therefore, seem to be a valuable additive to analgesic therapy in ferrets. However, scientific evidence for the efficacy and pharmacokinetics in ferrets is generally lacking.

Alpha-2 Adrenoceptor Agonistic Drugs

The use of medetomidine, the alpha-2 adrenoceptor agonistic drug, has been recommended for ferrets in low doses, based on the presumed more profound cardiovascular depressant effects of the higher doses.[16] In dogs, low doses of medetomidine are indeed associated with fewer cardiovascular side effects[52]; however, these doses have limited sedative and/or analgesic effects. In the perioperative setting, alpha-2 adrenoceptor agonists have been shown to be well tolerated at sedative doses in cardiovascular-stable animals in a range of species. More recent human and veterinary literature indicates a place for the alpha-2 adrenoceptor agonists as part of pain management and/or sedation in an intensive-care setting as well.[53–57] Therefore, administration of alpha-2-agonistic drugs as low-dose CRI might also be a valuable additive to analgesic therapy and sedation in the ferret.

NMDA-Receptor Agonists

CRI of ketamine combined with CRI of fentanyl during and after surgery has been clinically described to provide good analgesia for the ferret.[16] Additionally, the use of ketamine CRI postoperatively has been recommended as an additive to analgesic therapy with opioids or other analgesics.[11]Although potentially very useful as analgesic adjuncts, ketamine and tiletamine, another NMDA-receptor agonist, are considered to have poor analgesic actions in the ferret[11,39] when used alone.

Local Anesthetics and Locoregional Techniques

Using local anesthetics, for example, bupivacaine and lidocaine, can be very effective in preventing stimuli reaching the spinal cord and are very useful additions in a pain management plan. The authors recommend that locoregional techniques are only performed in ferrets that are adequately sedated or anesthetized. The good predictability of drug effect with respect to desired and unwanted side effects of local anesthetics and insensitivity to species-specific physiology make locoregional techniques an excellent choice in ferrets requiring anesthesia for surgery or painful diagnostic procedures. Techniques that can be used in ferrets are incisional line blocks, local infiltration, ring blocks, splash blocks, topical application, conductive nerve blocks, and even epidural anesthesia.[10,11,16,35] Care must be taken not to exceed maximum doses, which need to be calculated beforehand, often requiring dilution of the drug to obtain an adequate volume. Maximum doses are similar to those for dogs and cats—1 to 2 mg/kg.[10,11,16] Adding opioids, such as morphine or buprenorphine, to a local block is considered to increase the duration of analgesia significantly.[16]

Specific dental blocks in ferrets are executed in a similar fashion to those in dogs and cats and were described in detail by Lichtenberger and Ko.[16] These included the infraorbital, mental, mandibular, and maxillary nerve blocks. Two other local blocks described by these investigators are the palatine and intratesticular blocks. In the latter, sufficient time has to be allowed for the local anesthetic to migrate to the spermatic cord (minimally, 5 minutes) to benefit from this technique.

The use of epidural morphine in the ferret at a dose of 0.1 mg/kg was reported to provide significant analgesia for 12 to 24 hours, with limited or no clinical side effects.[17] A 1:10 dilution of oxymorphone at 0.022 mg/kg for epidural analgesia has also been described.[35]

Finally, the locoregional techniques frequently used in dogs and cats should be actively pursued and their use encouraged in ferrets.

SUMMARY

A sufficient amount of data on clinical efficacy, pharmacokinetics, and pharmacodynamics of analgesic drugs and specific behaviors related to pain in ferrets is lacking. This might hamper effective pain management in both clinical and research settings. However, the authors think that ferrets do not differ from any other species when it comes to pain management. In pain management, the golden cycle is *assessment–intervention–reassessment*.

Assessment of pain is difficult in any species, including humans. Pain is a highly subjective and individual experience, and similar surgeries or disease states are experienced differently by every individual. Therefore, a patient-orientated pain management plan with strategic assessment intervals is strongly advocated, especially in species, such as the ferret, in which scientific data are scarce.

Finally, analgesic treatment is a dynamic, practical, and subjective process. Therefore, *clinical experience* from colleagues working with ferrets and with appropriate training in pain physiology and pain management is at least as valuable as *hard scientific* data. Therefore, the authors encourage people to maintain adequate record keeping and follow-up, while continuing to report on their clinical experience with analgesics in ferrets until more scientific evidence is available.

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